

9. *Spinal Anesthesia*.—Morton and Scott found that if the sympathetic fibers innervating the blood vessels of the lower extremities were completely paralyzed, under temperature-controlled conditions, vasomotor spasm could be differentiated from organic obstruction.

Procain Hydrochlorid 0.100 to 0.120 gram is dissolved in a small amount of spinal fluid and rapidly injected intraspinally. Skin temperature measurements are taken at five or ten-minute intervals, as well as the pulse rate and blood pressure.

Three types of reaction are recorded: (1) no change in gradient, pointing to entire absence of vasospasm; (2) complete obliteration of the gradient, indicating that the peripheral disturbance is due entirely to vasomotor spasm; and (3) partial obliteration of the gradient, the peripheral surface temperature definitely elevated, but not reaching the normal vasodilatation level, demonstrating a mixture of vasospasm and obliterative processes.

Exceptions to the above for normal vessel response are found in patients with fever, or in those suffering from advanced carcinoma.

The normal vasodilatation-level has been fixed by the authors at 33 Centigrade. To estimate the element of organic obstruction in vascular disease, the maximum surface temperature reached after sympathetic paralysis is subtracted from this figure, this difference being termed the obstruction index.

Similar information, while not as complete or as accurate, may be secured by peripheral nerve block or paravertebral ganglion anesthesia.

10. *Arteriography*.—One of the measures outlined above usually suffices to differentiate between spasm and obliteration of the peripheral vessels, but there remains a comparatively small group of cases in which visualization of the peripheral arterial tree is extremely important as a diagnostic aid. Arteriography furnishes definite and useful information regarding the extent of the disease, the nature of the pathologic process and the physiologic compensation for the diminished flow of arterial blood as a result of occlusion of the main arterial passages.

Thorotrast, an opaque slightly radioactive substance, is utilized for this purpose. It is composed, by weight, of 19 to 20 per cent thorium oxid, and 16 to 19 per cent of a protective colloid. When introduced into the arterial circulation, it is engulfed by the reticulo-endothelial cells and very slowly excreted. The effects of its prolonged deposition within the body are, as yet, largely unknown.

The drug is injected in amounts varying from five to twenty cubic centimeters, depending upon the size of the subject and the area to be visualized, directly into the brachial or femoral arteries. Pressure is made and maintained above the site of injection, while a series of rapid x-ray exposures are made.

384 Post Street.

HYPERTENSION: ITS SURGICAL APPROACH

By FRANCIS M. FINDLAY, M.D.
Santa Barbara

DISCUSSION by Alfred E. Koehler, M.D., Santa Barbara; Franklin R. Nuzum, M.D., Santa Barbara; E. F. Holman, M.D., San Francisco.

INTRODUCTION: Operative results in over two hundred cases of hypertension were reported by various surgeons* at the recent meeting of the American College of Surgeons in San Francisco. In a small percentage of these hypertensive cases, the blood pressure has been maintained at a normal level for periods of from several months to two years after operation. These investigators also observed a definite amelioration of symptoms and an appreciable drop in blood pressure in over one-half of the operated cases. Such encouraging results, in a condition that has previously failed to respond to any medical measures, cannot be ignored. Every member of the medical profession should know of the recent progress in this field.

OUTLINE

It is the purpose of this paper, first, to restate the known physiologic and pathologic changes that accompany essential hypertension. Second, to review the fundamental structure and function of the sympathetic and adrenal systems, and to point out their probable influence upon blood pressure. Third, to describe briefly the operative procedures now in use, and attempt to evaluate them. Finally, to propose a more extensive operation, based upon our present anatomic and physiologic knowledge plus the experience gained from previous operations done upon the sympathetic and adrenal systems.

DEFINITION

Both pioneers and present workers in this field have been handicapped because the etiology of essential hypertension is unknown. In describing the condition, Sir William Osler stated: "The exact cause of this high tension is unknown. Some have attributed it to overactivity of the adrenals, but it is much more likely that the primary difficulty is somewhere in the capillary bed—in that short space where the real business of life is transacted." Osler described this condition as simple high tension without signs of arterial or renal disease, and favored Clifford Allbutt's term "hyperpiesa." The condition is well known to be a progressive disease, often occurring in young people. It is characterized in the majority of cases in its early stages by periods of excessive rise in blood pressure without other evidences of pathologic change or disease, and is commonly termed "primary" or "essential" hypertension.

The pathologic changes in the kidney, heart, and blood vessels that result from hypertension have been described. The symptoms due to hypertension are well known. Internists can forecast the probable outcome in a series of cases with a fair degree of accuracy; yet this ability to describe the phenomena related to hypertension affords no

* References will be given in the reprints.

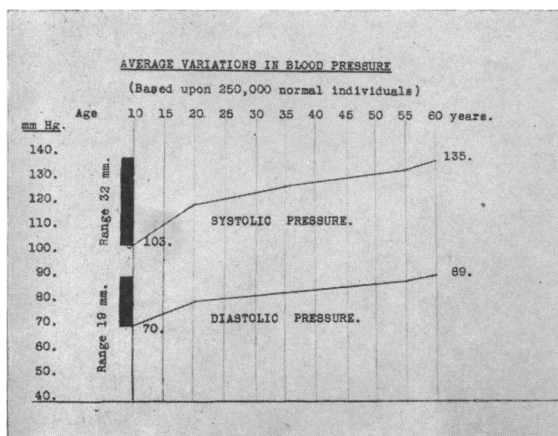


Fig. 1.

Fig. 1.—There is only a rise of 32 millimeters in systolic blood pressure in fifty years. (Chart courtesy of Dr. Harold Frost, Medical Director, New England Life Insurance Company.)

Fig. 2.—Very little permanent improvement can be expected in individuals with thickened vessel walls.

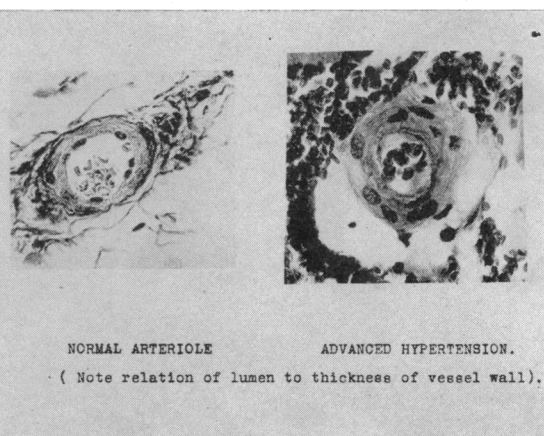


Fig. 2.

clue to the underlying cause. Many theories have been advanced as to its cause. Although hardening of the arteries often accompanies hypertension, it is improbable that arteriosclerosis ever causes hypertension. Kidney disease alone is responsible for only a small percentage of the total number of cases seen. No doubt there are some hereditary factors, for it is known that hypertension tends to run in families, and that men develop it more often than women. It is often associated with thyrotoxicosis and the menopause. Nervous tension and emotional distress contribute to its advance, and the disease usually progresses in spite of the most conservative or radical medical regimen.

STAGES OF HYPERTENSION

Livingston arbitrarily divides typical essential hypertension into five periods or phases. In the first phase, there is no permanent elevation of the blood pressure, and no kidney, heart or vascular lesions can be detected. However, the patient shows an increasing tendency to respond to minor physical and emotional stimuli by an excessive rise in blood pressure. Frequent observation reveals marked alterations in blood pressure during the twenty-four hours.

In the second phase, the pressure fluctuations become more acute and prolonged, and the blood pressure does not return to normal levels, but remains permanently elevated. While organic lesions have no doubt already appeared in the arterioles, they are not clinically demonstrable.

In the third phase, fibrosis of the arterioles with narrowing of the lumen can be seen under the microscope, and there may appear signs of kidney damage and perhaps an albuminuric retinitis.

In the fourth phase, the patient begins to experience symptoms ascribable to hypertension. There may be tinnitus, headache, dizziness or transient cerebral symptoms, failure of vision, kidney symptoms, or complaints indicating that the heart is no longer able to carry on efficiently under the excessive load.

Finally, if the patient is not carried off by some intercurrent infection or accident, he dies as a direct or indirect result of the arteriolar lesions,

usually from a cerebral accident, uremia, or cardiac failure. The term "malignant hypertension" has been reserved for the cases that rapidly progress to fatal termination within a few months after the onset of the initial symptoms.

In our experience, the symptoms of headache, pulsation of the vessels of the neck, nervousness, and a sense of constriction in the chest occur much earlier in the course of the disease than Livingston indicates. We would also emphasize the extreme rapidity with which some of the younger cases progress, often ending fatally within a few weeks from the initial onset of the first symptom.

However, we must finally conclude that the fundamental cause of essential hypertension is still unknown. Any attempt to deal with this condition must be undertaken with this fact in mind. The various surgical attempts now being made may not only relieve the symptoms of hypertension, but may contribute some fundamental facts toward the real cause of essential hypertension.

CLASSIFICATION OF CASES

Because the etiology of primary or essential hypertension is not clearly known, much confusion exists in classifying and selecting cases. In the operated cases reported to date, there has been no apparent effort to separate the true cases of early essential hypertension from those with extensive renal damage or gross organic changes in the vessel walls. Several of these cases had marked changes in the fundus oculi; in a few retinal hemorrhages were recorded prior to operation, some had partial paralysis of an extremity from previous stroke; while in others there were urinary findings indicating extensive kidney damage from glomerular nephritis. All operators, however, agree that patients in the younger age groups with hypertensive symptoms of persistent nature, with minimal evidence of organic arterial change and without permanent renal damage, are the best candidates for operation and offer favorable prospects for a cure.

In general it seems that gross arteriosclerotic changes in any individual, marked impairment of renal function or other secondary complications

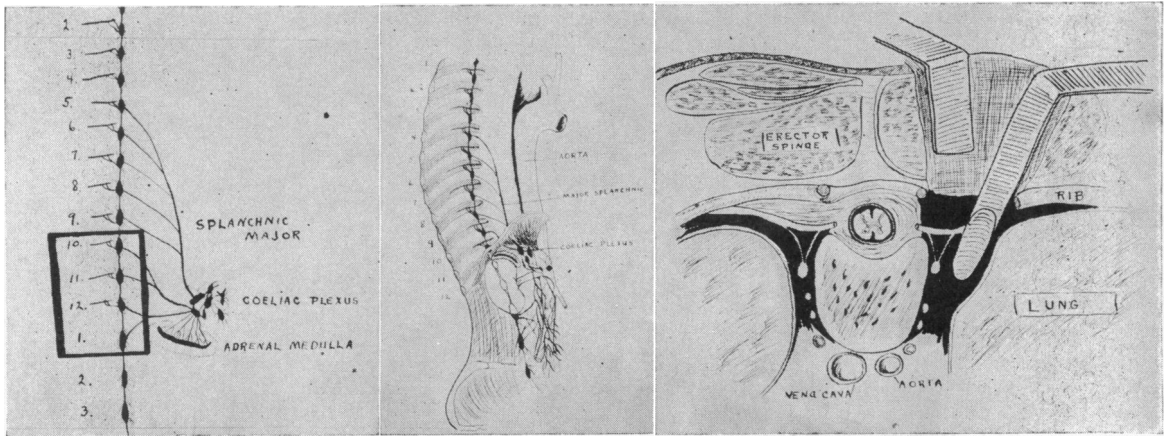


Fig. 3.

Fig. 4.

Fig. 5.

Fig. 3.—Operations done now, which only section splanchnic major and remove the lower thoracic ganglia, do not permanently denervate the splanchnic area.

Fig. 4.—Lateral view of sympathetic chain and relation to coeliac ganglion and adrenal medulla.

Fig. 5.—Posterior approach to dorsal ganglionectomy and splanchnic resection.

would be a contraindication at the present time for this type of operation. On the other hand, some surgeons have felt that until further knowledge is at hand, there are no real contraindications, and the operation should be done on all individuals with a systolic blood pressure over two hundred, disregarding other evidences of advanced pathology.

DETAILED DESCRIPTION ESSENTIAL

It is essential in the future that any report of cases include a careful description of the type of cases selected for operation. Observations should be recorded as to the vascular condition, the flexibility and range of the blood pressure, the elasticity of the blood vessels, kidney and urinary changes present in each individual prior to operation, as well as the fact that the systolic blood pressure is usually over two hundred. Cases should be followed at frequent intervals for at least a year before results are reported. It is impossible to compare results obtained by different surgeons during the past two years, because the standards for selection of cases have varied. Most of the preliminary reports submitted have not included a detailed study of each individual case. No doubt future reports will give us added details and a clearer picture of each operated hypertensive case.

NORMAL VARIATIONS IN BLOOD PRESSURE

In any consideration of hypertension it is essential to remember that many individuals at intervals in their youth and young adult life may show periods when their blood pressure readings are distinctly above normal, yet in later life will have normal pressure. Single readings have very little value in determining the true status of an individual who is suspected of having essential hypertension. Only by repeated observations over a long period of time can the true picture be seen. Many young individuals from nervousness or some other cause show abnormally high readings of the blood pressure at the first examination, yet repeated subsequent examinations show normal values. With these facts in mind, no patient

should be subjected to a procedure which is still definitely experimental until careful observation has shown that individual to be a true case of essential hypertension and that other measures fail to give reasonable prospects of recovery.

SYMPATHETIC ADRENAL INFLUENCE

Because no definite etiologic factors have been found, some writers have assumed that a constitutional abnormality of the sympathetico-adrenal system plays an important part in the production of essential hypertension. Before discussing the surgical approach in this condition, a brief review of the known facts concerning the structure and function of the autonomic nervous system, and the adrenal glands and their possible influence upon hypertension is indicated. The normal anatomy and physiology of the sympathetic nervous system is not well known by the average surgeon today.

AUTONOMIC INFLUENCE

Our knowledge of the autonomic nervous system and its influence upon the circulation, although gradually accumulated, is still incomplete. Galen, John Hunter, Brown-Séquard, Claude Bernard, François-Franck, Cannon, and Leriche have each contributed to our fund of knowledge. Bernard showed that the remarkable ability of the body to maintain a constant temperature, in spite of its changing external environment, was made possible by the autonomic nervous system through its influence upon the vasoconstrictors and vasodilators of the blood vessels. Cannon showed that it was the sympathetic division which controlled vasoconstriction of the blood vessels, and that surgical shock, with its pronounced fall in blood pressure, was in large degree due to dilatation of the visceral blood vessels.

SYMPATHETIC CONTROL THROUGH BLOOD VESSELS

Accumulated observations of many workers show that apparently the entire sympathetic control of our extremities, and of many of our organs, is exercised through the action of the vasoconstrictors of the blood vessels to these parts.

The increase in temperature of an extremity, either following spinal anesthesia or blocking of the peripheral nerves with novocain or alcohol, is entirely dependent upon the increased blood supply which follows temporary or permanent interruption of the sympathetic influences which affect constriction of the blood vessels.

On the other hand, the disturbed vasospastic mechanism of Raynaud's disease, with the lowered temperature in the affected extremity, the cold, clammy, cyanotic digits and the pain from anoxemia, quite definitely demonstrates the diminished blood supply which follows increased sympathetic activity, and its effect upon the blood vessels of the extremity. Although increased adrenalin secretion is probably the cause of this increased vasomotor discharge, it seems quite clear that sympathetic control of the extremity is exerted entirely through the vasoconstrictor fibers to the blood vessels.

This same mechanism that controls the rate of blood flow in the extremities is apparently the chief factor in the sympathetic control of various organs and glands within the body cavity. Claude Bernard, in 1877, first showed that cutting the splanchnic nerves increased the blood flow to the kidney with increased secretion of urine. This observation has been confirmed more recently by Quinby, Sangree, and Hess, and other observers, both in animals and in man. All investigators agree that sympathetic denervation of the kidney causes no change in the elimination by the kidney of salt, urea, and many other substances. These findings suggest absence of actual secretory fibers to the glomerular tubules, and that the splanchnic nerve's only action on the kidney is to control the amount of blood flow through the renal vessels.

This action of the autonomic nervous system upon blood vessels is again demonstrated in the sex organs where sexual excitement is accompanied by engorgement of the blood vessels to that region. Kuntz showed, in 1929, that although the ovary is abundantly supplied with nerve fibers, the distribution of these is limited to the blood vessels, and that the engorgement of all pelvic organs is the direct result of sympathetic action upon blood supply. This physiologic fact that the sympathetic nerve supply is chiefly directed to the control of blood flow to the extremities, organs and glands in various parts of the body, seems to be the real basis for the hope of lowering blood pressure in cases of true essential hypertension.

RENAL VASOCONSTRICTION A FACTOR

Further study of the sympathetic influence upon the circulation has led to the discovery of another mechanism, renal vasoconstriction, which appears to be a factor in the production of essential hypertension. The production of renal ischemia by clamping the renal arteries in dogs has produced an experimental form of hypertension that is similar in many respects to essential hypertension as seen in man. Two workers have thrown considerable light upon the underlying problem of hypertension. Richards has recently shown that stimulation of the splanchnic nerves will increase

aortic blood pressure by causing vasoconstriction of the afferent artery to the glomerulus. This, of course, produces diminished glomerular pressure with consequent impairment of kidney function. It was previously thought that essential hypertension was due to a generalized vasospasm of the entire arterial system. This is the first time that it has been shown that constriction of a single portion of circulatory system will result in hypertension.

Supplementing these observations, Goldblatt, and his co-workers, in a group of very carefully controlled experiments, have produced and maintained hypertension in a group of dogs for an average period of over one year. He accomplished this by producing constant renal ischemia with a clamp upon the renal arteries. He has shown that it is essential to produce renal ischemia rather than limit the circulation to other parts of the body; for vasoconstriction of other large vessels like the splenic and the iliac arteries failed to alter the blood pressure.

While Richards and Goldblatt have not as yet explained the mechanism of this elevation of blood pressure, they have shown that renal ischemia is a factor. Since renal artery vasoconstriction produces hypertension and since splanchnic nerve stimulation increased blood pressure while decreasing kidney function in experimental animals, it logically follows that there may be some cases of hypertension in man due to renal artery vasoconstriction. These cases should improve from splanchnic nerve section by increasing kidney circulation and lowering blood pressure.

ADRENAL INFLUENCE

The influence that the adrenal glands exert in the production of hypertension is not definitely known. Many facts point toward these glands as being intimately associated with the production of hypertension. Embryologically the origin of the medullary portion of the adrenal, and of the sympathetic nervous system are identical. Their cells show similar histologic structure. Epinephrin, which is elaborated in the medullary portion of the gland, exerts its physiologic effect primarily upon the muscles which constrict the blood vessels which in turn are innervated by sympathetic fibers.

Koehler has observed that the adrenalin content in the suprarenal glands removed at operation in a small series of hypertensive cases is roughly proportional to the elevation in blood pressure. Although some of the glands contained less adrenalin than is usually considered the normal value, his patients with the highest blood pressure had the most adrenalin in their suprarenal glands, while those with the lower pressure readings consistently had less adrenalin in their glands.

Pincoffs has reported two cases of medullary tumor of the adrenal associated with severe hypertension. Removal of the tumor in both of these cases resulted in return of normal blood pressure. Porter, Shipley, and Belt have also reported similar cases of medullary tumor accompanied by hypertension. The vast majority of cases of hypertension, however, show no tumor of either

adrenal. Crile and Goldzieher have maintained that hyperactivity of the medullary portion of the adrenal was the fundamental cause of this elevated blood pressure, and have likened the condition to hyperthyroidism. Aside from the occasional medullary tumor, no definite pathologic change has been discovered to date in the adrenals of individuals suffering from hypertension. The analogy between the thyroid gland in hyperthyroidism and the adrenal gland in hypertension does not seem to be justified.

Other evidence tends to show that the adrenals exert little or no influence in hypertension. Hines and Brown have shown that bilateral adrenalectomy in dogs does not prevent the pressor response to cold. The consensus of opinion, as represented by the works of Page and Heuer and Soma Weiss, seems to be that there is no evidence of an increased amount of pressor substance in the blood in essential hypertension as determined by either chemical means or vascular responses.

However, the embryologic development and the histologic structure of the adrenal medulla, with its large sympathetic nerve supply, lead the careful observer to conclude that there is some definite relationship between the adrenal glands and the autonomic nervous system.

ADRENAL SURGERY

Surgical attempts to control hypertension to date have consisted in operations upon the adrenal glands and upon various portions of the sympathetic nervous system.

Over twenty years ago Crile practiced partial adrenalectomy and denervation of the opposite adrenal to control hypertension. He writes that his results have been unsatisfactory and two years ago he gave up partial adrenalectomy and denervation for resection of the splanchnics. De Courcay, at the present time, champions the cause of the adrenal. He has advocated and practiced subtotal bilateral adrenalectomy with striking immediate results. White feels that his cases have been followed for too brief a period to draw any conclusions as to final results. Lahey, Smithwick, and Palmer have been unable to duplicate the favorable results of De Courcay and have given up the operation. Ussher has observed favorable results from bilateral subtotal adrenalectomy in a single patient carefully observed and followed for over a year. Koehler records a striking drop in blood pressure following bilateral adrenalectomy in a case followed for six months. It is too soon to discard the adrenal entirely.

It is improbable that bilateral adrenalectomy will have many advocates until its superior advantages over other procedures are shown, for the immediate operative risk in adrenalectomy is considerable, several operative deaths have occurred, and the danger of acute adrenal insufficiency developing is very great.

SYMPATHETIC SURGERY

Many observers have thought that interruption of the vasoconstrictor influences to a large portion of the vascular bed would have a depressor

effect in early cases of essential hypertension. As the splanchnic nerves control a large portion of the visceral blood supply, they have been among the first objects of surgical attack.

Danielopolu first suggested resection of the splanchnic nerves for hypertension in 1923. Pende, in 1925, proposed section of the left splanchnic nerves, and Pieri, in 1930, actually did unilateral section of the splanchnic nerves for hypertension. Peet was first in this country to do bilateral resection of the splanchnics for hypertension, and has reported one hundred patients upon whom this procedure has been carried out in the past three years. Craig has also advocated a similar operation.

The results obtained by surgeons to date have been quite uniform in that section of the splanchnic nerves has resulted in an immediate drop of at least forty to fifty points in the systolic blood pressure, but in many cases this improvement has been only temporary and careful observation warrants the belief that either insufficient fibers have been removed or else regeneration has taken place. Adson and Mixter have both reported cases in which rhizotomy of the posterior roots of the lower dorsal and upper lumbar segments have resulted in marked fall in pressure that is apparently permanent, so that it is quite evident that interruption of enough sympathetic fibers will lower the blood pressure.

OPERATIVE TECHNIQUE

The technique that Peet follows for resection of the splanchnic nerves consists in bilateral removal of a section of the greater splanchnic nerve about eight centimeters long, together with excision of the tenth, eleventh, and twelfth dorsal sympathetic ganglia, and the lesser and least splanchnic nerves, if present. This operation is done above the diaphragm through a posterior incision with resection of small portions of the eleventh rib, and is accomplished with a minimum of shock to the patient.

Adson and Craig of the Mayo Clinic advocate division of the splanchnics below the diaphragm with removal of the first or second lumbar sympathetic ganglia to interrupt the ganglionic chains, and more recently have combined this operation with partial adrenalectomy.

We are considerably stimulated in the study of essential hypertension by the various attempts that have been made to attack the problem surgically. It is quite evident from the variable results which have been reported that we have not found the ideal operation.

INCOMPLETE DENERVATION

Failure in many instances would appear to be due to incomplete removal of all the sympathetic nerve supply. We must remember that the autonomic nervous system is not a separate and distinct unit, but that it has many connections with the central nervous system. The splanchnic nerves especially are made up of many different preganglionic fibers which regenerate rapidly unless

the cell bodies from which they arise are destroyed. Smithwick, Freeman, and White have shown that regeneration of preganglionic fibers takes place within a week. Bard feels that the secretory fibers going to the adrenal medulla regenerate very rapidly. It is quite certain from our present evidence that an adequate drop in blood pressure can be obtained in many hypertensive cases if sympathetic fibers can be completely and permanently removed from an adequate visceral area. Both Adson and Mixter have shown that posterior rhizotomy lowers blood pressure, but is too crippling an operation for practical use. It would appear that more complete removal of the splanchnic nerves is the next logical step in this approach. This, no doubt, has been in the minds of other workers, but we are not aware that the procedure has been carried out.

FACTS FAVORING EXTENSIVE GANGLIONECTOMY

Holman has observed that section of the major splanchnic nerve in man consistently accounts for a marked immediate drop in the systolic blood pressure, while section of the splanchnic minor, which innervates chiefly the adrenal glands, is accompanied by relatively little change. The major splanchnic is the main nerve supply of the renal blood vessels, and section of it probably causes vasodilation of the renal afferent arteries with increased renal circulation, and subsequent lowering of the systemic blood pressure. The splanchnic nerves are composed chiefly of preganglionic fibers, which regenerate rapidly in animals and presumably in man unless the cells from which they arise are destroyed. Section of these nerves should be accompanied by removal of the fifth to twelfth dorsal sympathetic ganglia to effect permanent denervation. The present operations of removing only the tenth to twelfth dorsal ganglia divide only the origin of the splanchnic minor and least nerves, as the splanchnic major receives fibers from the fifth to ninth dorsal ganglia inclusive. The present operation is, hence, an incomplete denervation.

This operation can readily be performed through a posterior incision, removing a section of the seventh rib in a similar manner to the present operation for removing the lower dorsal ganglion. It is true that all these procedures have possible grave dangers in the disturbances of motility of the gastro-intestinal tract, and altered secretion of other glands and organs innervated by the splanchnic nerves. However, section of the splanchnic nerves and removal of sympathetic ganglia do not carry the immediate operative mortality associated with adrenalectomy, or result in extensive paralysis of the abdominal muscles that follows rhizotomy. Until further study reveals more of the etiology of this condition, this procedure would seem warranted on some of the cases of hypertension which are not responding to more conservative measures.

SUMMARY

1. While the etiology of hypertension is unknown, the physiologic and pathologic changes characteristic of the disease have been reviewed.

2. The sympathetic nervous system plays a large part in the control of blood pressure. Increased sympathetic discharge or altered adrenal secretion would appear to be a large factor in the production of hypertension.

3. Present operative attempts show promising results in a large number of cases and warrant careful study of all factors involved.

4. Further modification of present procedure is suggested, based upon our past experience and anatomic facts.

1515 State Street.

DISCUSSION

ALFRED E. KOEHLER, M. D. (317 West Pueblo Street, Santa Barbara).—Doctor Findlay has presented a timely review of an exceedingly important problem. The internist will have to concede, at least for the present, that the surgeon has made an aggressive attack on the hypertensive problem that merits consideration as a most promising therapeutic measure. The present methods of approach, either sympathetic resection or suprarenal surgery, will be instrumental after the elapse of some years in yielding information not only as to the therapeutic value of these procedures, but as to the etiology of hypertension.

Our approach in Santa Barbara has been largely that of bilateral partial suprarenalectomy. Some of our cases have gone from one to two years after operation, and there can be no doubt as to the dramatic reduction in blood pressure. As yet we have seen no evidence of suprarenal regeneration. Our policy has been to wait at least three months between the first and second stage, thus giving sufficient time for complete organization of the gland remnant. We believe this to be highly important in reducing mortality.

We have been prejudiced against sympathetic resection for the following reasons: (1) The fibers cut are postganglionic and, therefore, will regenerate in a comparatively short period of time. (2) Sympathectomy, after a period of time, markedly increases the vascular sensitivity to epinephrin. (3) Relief after lumbar sympathectomy is only visceral and, consequently, does not relieve peripheral arteriole spasm. Lowering of systemic blood pressure without removing peripheral resistance must result in diminished circulatory efficiency in these tissues. (4) Visceral sympathectomies may interfere in bowel innervation and function.

Of utmost importance in any procedure is thorough observation and study of the various factors related to hypertension for long periods, both before and after operation.

✻

FRANKLIN R. NUZUM, M. D. (Cottage Hospital, Santa Barbara).—Limiting this discussion to conclusion No. 2 of the summary, that "the sympathetic nervous system plays a large part in the control of blood pressure," and "increased sympathetic discharge or altered adrenal secretion would appear to be a large factor in the production of hypertension," the notion that an increased production of adrenalin is an etiologic factor in hypertension is of long standing. Numerous attempts have been made to measure the amount of adrenalin in the blood stream. There are now recorded upward of one hundred such chemical tests. The number bespeaks the nonacceptance of any one. The biologic method of assay is difficult and time-consuming in technique. By such methods it has been determined that the concentration of adrenalin in the blood leaving the adrenal vein is one part to 350,000; in the circulating blood, the concentration is about one part to 100,000,000. With such a dilution, it has been, and is as yet impossible to say that adrenalin *per se* is associated with the etiology of hypertension.

Many physiologists, especially Cannon, believe that adrenalin is discharged intermittently during times of fear, anger, etc. Their notions are opposed to this agent's being

an etiologic factor in hypertension. It is fair to say that the thesis remains to be proved; that adrenalin is etiologically important in this situation, and that only time will prove or disprove the efficacy of the surgical measures now being advocated for the treatment of this widespread and important condition.

✽

E. F. HOLMAN, M. D. (Stanford University Medical School, San Francisco).—The problem of hypertension has been ably presented by Doctor Findlay. Ignorant of its etiology, clinicians are groping rather blindly for some method more effective than any medical treatment so far presented. At present one can predict with considerable assurance the probable outcome in a given case, treated or untreated. To modify the hitherto inexorable progress of the disease, various operations are being employed, obviously empirical, since the cause of hypertension is unknown. Such empirical measures can result only in a marked diversity of results.

The reported successes following splanchnicectomy are encouraging, yet again, one cannot predict with any certainty what the outcome will be. The tangible benefits in our experience have been a definite subjective improvement in all, but a marked lowering of the blood pressure in only two of the eight cases subjected to this operation. Such experience will undoubtedly tend to restrict the operation much more rigidly to a narrow group, namely, younger patients who show few evidences of peripheral and retinal arteriosclerosis and a minimal damage to the kidneys. Because of its experimental nature, the operation should not be universally applied, but limited to such clinics as are able and willing to conduct all the studies designed to give a better understanding of the disease and a clearer appraisal of all the effects of the operation, beneficial or otherwise, upon the organs supplied by the splanchnic nerves.

✽

DOCTOR FINDLAY (Closing).—I am deeply indebted to the discussers of this paper for their kind criticism, and I wish to express my appreciation to them for reviewing this communication.

Doctor Koehler has given four objections to sympathetic resection. A more extensive ganglionectomy such as outlined in this paper will prevent regeneration of the splanchnic nerves, and thus remove his first objection. His second objection, that the denervated extremity has increased sensitivity to adrenalin, is valid. It appears inconceivable, however, that subtotal removal of both adrenals could come any nearer solving the problem when physiologic responses in normal individuals are obtained from blood serum containing only one part of adrenalin in 100,000,000. Since it has not been demonstrated that all of the pathology of essential hypertension lies in the capillary bed, or that increased adrenal secretion is the cause, his third objection holds against adrenalectomy as well as against sympathectomy. His fourth objection should not be ignored; but Cannon's work on animals and the clinical observations upon human patients who have been subjected to extensive sympathetic surgery, fail to show any serious interference with the function of the gastro-intestinal tract.

I am glad that Doctor Nuzum has reemphasized that the etiology of essential hypertension is unknown. Any assumption that altered adrenal secretion is a factor in its production is still an unproved theory rather than an established fact.

I am grateful to Doctor Holman for so kindly adding his own experience and reminding us that progress in this field will not be made unless careful and thorough preliminary studies by competent observers precede surgery. A thorough follow-up over a period of several years, with complete reporting of failures as well as successes, will enable us in time to appraise our work.

We are well aware that the answer to this problem may lie entirely outside the field of surgery, possibly in the field of endocrinology or biochemistry.

THE MEDICAL MANAGEMENT OF PEPTIC ULCER*

By GEORGE A. COCHRAN, M.D.
Salt Lake City, Utah

DISCUSSION by Lowell D. Snorf, M.D., Chicago, Illinois; Frederick A. Speik, M.D., Los Angeles.

PEPTIC ulcer seems to be increasing, due to nervous tension attributable to our complex living requirements. The causes may be (1) nervous tension, (2) heredity and family tendency patterns, and (3) focal or residual infections of the blood vessels in the stomach and duodenum. The hydrochloric acid secretion is a necessary concomitant factor for the formation or continuation of the ulcer. The statement that these ulcers are peptic is accepted universally.

ETIOLOGY

Ulcer patients, as a type, display nervous tension and irritability, and do not readily relax. It has been noted that among the Indians of Mexico ulcer is unknown,¹ although coarse and deficient food and unhygienic living prevail. As coronary and sclerotic heart disease occur in the high-pressure brain worker, likewise ulcer is common in this class. Ulcer is not infrequently associated with brain injuries and tumors. Emotional stimuli cause a pouring out of epinephrin, which produces vascular spasm, ischemia and necrosis, and the hydrochloric acid completes the ulcerative processes.

We are often impressed with the history of ulcer in families. I have in mind a family in which the father and five of eight children were found to have peptic ulcer. The male sex is susceptible in the ratio of five or six to one, in large series of ulcer cases.

CLINICAL HISTORY

The manifestations of ulcer are only recognized by a careful clinical history. Experience is a requisite in acquiring a technique of diagnosis. A majority of patients have a history of having had stomach trouble for ten or more years. Occasionally we see cases which have had symptoms for only two or three months, and alertness is essential or the diagnosis may be missed. Cases of short duration must be studied with thoroughness because of the possibility of malignancy. Intermittent dyspepsia over fifteen or twenty years removes them from the latter class. Ulcer patients are characterized by periodicity of symptoms; but as the disease progresses the periods of freedom are shortened, and with the development of the complications of pyloric spasm, food retention, continued secretion, and involvement of deeper structures, the symptoms are persistent.

The distress of ulcer may be described as dull pain, burning in the epigastrium, feeling of fullness or merely discomfort. In uncomplicated ulcer, the pain is sharply localized to the epigastrium.

* Read before the Nevada State Medical Association at its thirty-second annual session, Elko, October, 25-26, 1935.

¹ Statement of physicians interviewed by author while on tour of Mexico in August and July, 1935.